JAPANESE PATENT OFFICE

PATENT JOURNAL

KOKAI PATENT APPLICATION NO. HEI 3[1991]-44955

Int. Cl.[5]:	H 01 L	23/50
	H 01 L	25/08
		27/14
	H 01 L	25/065
		25/07
		25/16
		25/18
		27/00
		22/14
Sequence Nos. for Office Use:	9054-5F	
	7038-5F	
	7377-5F	
	7638-5F	
	7514-5F	
Application No.:	Hei 2[1990]-172548	
Application Date:	June 29, 1990	
Publication Date:	February 26, 1991	
Priority:		
Date:	June 30, 1989	
Country:	U.S.	
No.:	373,972	
No. of Claims:	36 (Total of 9 pages)	
Examination Request:	Not Requested	

HIGH INDIUM AND ALLOY BUMP ARRAY FOR IR DETECTOR HYBRID OR MIRCROELECTRONICS

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[There are no amendments to this patent.]

Claims

1. A method for forming the array of a connector column having an extended length for use as a microcircuit connector in a hybrid detector array device, characterized by the fact that it contain the following steps:

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[1] [Names and addresses are transliterations.]

a step in which a selection is made for the interconnecting pads positioned at the array corresponding to each array of the sensor contact elements and read contact elements, which have plural hollow metal tubes set in a film carrier with the tubes interconnected;

a step in which the end portions of the tubes are dipped in a melted metal selected appropriately so that the metal is fed due to capillary action to fill the tubes;

a step in which the interconnecting pads are cooled so as to solidify the filled metal;

a step in which the metal tubes are etchf to remove the carrier;

and a step in which the filled metal columns are connected between the contact elements set facing each other of the various detectors and read chips for completing the hybrid detector array device.

2. The method described in Claim 1, characterized by the fact that it has a step in which indium bumps are set on various contact elements of the detectors and the read chips so as to facilitate the connection of the corresponding columns.

3. The method described in Claim 2, characterized by the fact that the tubes filled with the metal of interconnecting pads are set on the indium bumps of the contact elements of the read chips before the etching step.

4. The method described in Claim 1, characterized by the fact that the selected filling metal is indium.

5. The method described in Claim 1, characterized by the fact that the selected filling metal is a prescribed alloy.

6. The method described in Claim 1, characterized by the fact that the hollow metal tubes are made of copper.

7. The method described in Claim 6, characterized by the fact that the etching solution is ammonium sulfate.

8. The method described in Claim 6 characterized by the fact that it has a step in which nonelectrical [sic, electroless plated] nickel layers are arranged on the inner surfaces of the copper tubes before the step of impregnation.

9. The method described in Claim 1 characterized by the fact that the hollow metal tubes are formed of nickel.

10. The method described in Claim 1 characterized by the fact that it has a step in which the interconnecting pads are cleaned and processed before the step of dipping.

11. The method described in Claim 10 characterized by the following facts: the step of selection of the interconnecting pads includes a step in which a mask is formed to attenuate lights from the selected detector array pattern; in this step of selection of the interconnecting pads, pads equipped with the hollow metal array corresponding to the mask are used.

12. The method described in Claim 4 characterized by the fact that it has a step in which the indium columns are tapered; in addition, 2 groups of indium columns are formed, and each group of the indium columns is installed on the contact elements of the corresponding detectors and read chips that should be interconnected; then, the free end portions of the indium columns are connected such that a columnar spacing having twice the height is formed between the chips;

13. The method described in Claim 12 characterized by the fact that the small end portions of the indium columns of each group are connected such that an integrated column is informed essentially in the shape of an hourglass is formed.

14. The method described in Claim 12 characterized by the fact that the smaller-diameter end portions of the indium columns in each group are connected to their corresponding chip contact elements, such that connection can be made to the contact portions having diameters smaller than what can be used by only one group of connector columns.

15. A method for forming a focal plane array device characterized by the following facts: in the focal-plane array device, the focal-plane array corresponds to a prescribed pattern containing interconnections between multiple indium columns between each facing pair of the contact elements of the focal-plane array detector and the read microchip;

wherein this method contains the following steps:

a step in which a focal-plane array pattern is used to form a mask for attenuating light;

a step in which a focal-plane array mask and interconnected pads equipped with copper tubes corresponding to the specifications of the focal-plane array mask are used;

a step in which the interconnected pads are cleaned and prepared for dipping processing;

a step in which pads are dipped in melt indium, and dipping is continued until the tubes are filled with indium by means of the capillary action;

a step in which the indium-filled tubes are moved to the read chips, and the tubes are cold-welded to the indium bumps on the pads; in this way, one end of each indium-filled tube is installed on an individual contacting pad on the read chips;

a step in which the base copper tubes are etched with ammonium sulfate to remove the carrier film;

a step in which the carrier film is raised from the array of the indium columns;

and a step in which the detector chips are arranged in a position aligned with the indium columns, and the upper end portions of the columns are cold welded with the indium bumps on the sensor chip by means of pressure welding;

16. A method for interconnection of one group of indium columns generated by the method described in Claim 1.

17. A type of hybrid detector array device formed by the method described in Claim 2.

18. The hybrid detector array device formed by the method described in Claim 4.

19. The hybrid detector array device formed by the method described in Claim 13.

20. The hybrid detector array device formed by the method described in Claim 14.

21. A type of hybrid detector device that can sense IR radiation characterized by the fact that it contains the following means:

a detector module containing multiple IR sensors arranged in a prescribed array;

a read module containing multiple contact pads arranged in a prescribed array on the substrate;

and a means which supports two modules in an interconnected relationship, and which positions multiple extended columns made up of electroconductive material between the corresponding sensors of the detector module array and the contact pads of the read module array so as to ensure that the device can work appropriately under variations in temperature between standard

room temperature and low operating temperature that may take place when using one of the two modules.

22. The device described in Claim 21 characterized by the fact that the material for the aforementioned columns is indium.

23. The device described in Claim 21 characterized by the fact that the material for the aforementioned columns is a solder alloy.

24. The device described in Claim 21 characterized by the fact that columns are connected with the contact pads by means of indium bumps.

25. The device described in Claim 24 characterized by the fact that the columns are also connected to the IR sensors by means of the indium bumps.

26. The device described in Claim 24 characterized by the fact that the various prescribed arrays have a configuration with similar multiple sensors and contact pads arranged in a corresponding relationship to each other.

27. The device described in Claim 22 characterized by the fact that the columns are formed as follows: the array of hollow copper tubes are dipped in melted indium, and the indium in the tubes is solidified by cooling; the copper tubes are then removed by means of selective etching.

28. The device described in Claim 23 characterized by the fact that the columns are formed as follows: the array of hollow copper tubes are dipped in melted solder, and solder inside the tubes is solidified by cooling; the copper tubes are then removed by means of selected etching.

29. A type of missile characterized by the following facts: the missile has a propulsive system, a guiding system, which

contains a hybrid detector device that can sense IR radiation, and a load;

the device has the following means:

a detector module which contains plural IR sensors arranged in a prescribed array;

a read module containing multiple contact pads arranged in a prescribed array on the substrate;

and a means which supports two modules in an interconnected relationship, and which positions multiple extended columns made of electroconductive material between the corresponding sensors of the detector module array and the contact pads of the read module array so as to ensure that the device can work appropriately under variations in temperature between standard room temperature and the low operation temperature that take place when using one of the two modules.

30. The missile described in Claim 29 characterized by the fact that the material for making the aforementioned columns is indium.

31. The missile described in Claim 29 characterized by the fact that the material for the aforementioned columns is a solder alloy.

32. The missile described in Claim 29 characterized by the fact that the columns are connected with the contact pads by means of indium bumps.

33. The missile described in Claim 32 characterized by the fact that the columns are also connected to the IR sensors by means of indium bumps.

34. The missile described in Claim 29 characterized by the fact that the various prescribed arrays have a configuration with

similar multiple sensors and contact pads arranged in a corresponding relationship to each other.

35. The missile described in Claim 30 characterized by the fact that the columns are formed as follows: the array of hollow copper tubes are dipped in melted indium, and indium inside the tubes is solidified by cooling; the copper tubes are then removed by means of selective etching.

36. The missile described in Claim 31 characterized by the fact that the columns are formed as follows: the array of hollow copper tubes are dipped in melted solder, and the solder in the tubes is solidified by cooling; the copper tubes are then removed by means of selective etching.

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